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(71) Applicant: IIT RESEARCH INSTITUTE [US/US]; 10 West 35th Street, Chicago, IL 60616-3799 (US).

(72) Inventors: SRESTY, Guggilam, C. ; 8241 South Mason, Burbank, IL 60459 (US). DEV, Harsh ; 6033 North Sheridan Road, Apartment 43D, Chicago, IL 60660 (US). GINSBERG, Robert, James ; 3 Hockanum Road, Westport, CT 06880 (US). ADLER, John ; 1623 Pelican Cove Road, Apartment 123, Sarasota, FL 34212 (US).

(74) Agents: WATT, Phillip, H. et al.; Fitch, Even, Tabin & Flannery, 135 South LaSalle Street, Chicago, IL 60603 (US).

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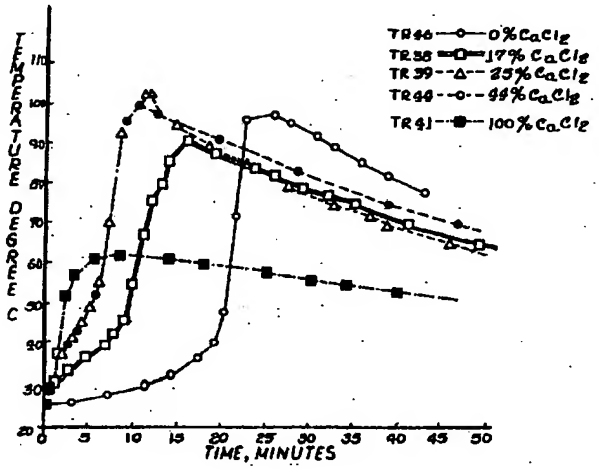

(57) Abstract

A warmer pack (11) is disclosed for maintaining fast food or carry-out food warm for an extended period of time, e.g., 20 to 30 minutes. The prewarmed food is kept warm at about its serving temperature, usually about 140°-150 °F. The preferred warmer pack (11) is inexpensively formed of parallel flat sheets of plastic defining a package. The preferred package includes two or more exothermic materials (25) and (29) separated by an internal frangible seal (21) which is broken by compressing the pack. The warmer pack is either initially preheated, or uses the heat of the prewarmed food, or has a first fast exothermic reaction to raise the temperature of the other compound therein and thereafter an exothermic reaction of the second compound continues over the extended period of time at a rate to offset the cooling rate of the prewarmed food. The warmer pack is food safe, inexpensive and provides heat transfer in a controlled manner to the prewarmed food.

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METHOD AND APPARATUS FOR WARMING FOOD

Field of the Invention

In general, the present invention is directed to a method and apparatus for maintaining food materials warm. More particularly, the present invention is directed to a food warming device and to a method and apparatus which utilizes a warmer pack to maintain a fast food carry-out material, such as hamburgers and other sandwiches, chicken and pizza, at an elevated temperature above ambient for an extended period of time.

Background of the Invention

Various prior art methods and apparatus have been proposed to provide a portable, flameless heat source based on the use of a chemical exothermic reaction. Such prior art methods and apparatus operate without production of gaseous by-products, and they do not require an external high temperature energy source to initiate heat production. However, none of the prior art methods and apparatus are directed to the problem of using such disposable warmers to keep warm foods until the foods are consumed on the premises or in the case of fast food carry-out businesses to keep the food warm in containers until the consumer has a convenient opportunity to eat the food material at a remote location. Considering the huge volume and relatively low cost of fast foods (over three billion hamburgers and one billion pizzas per year in the United States), it is apparent that a chemical thermal pack intended for use in association with fast foods must be simple and inexpensive to manufacture. Prior art chemical thermal packs and food heating devices have primarily been directed to premium high cost products where simplicity,

ease of manufacture and cost were not the prime considerations.

Typical prior art patents and references include the following:

U. S. Patent No. 3,874,504 to Verakas
U. S. Patent No. 3,550,578 to Fearon et al.
U. S. Patent No. 3,542,032 to Spencer, Jr.
U. S. Patent No. 3,561,424 to Failla
U. S. Patent No. 3,653,372 to Douglas
U. S. Patent No. 3,970,068 to Sato
U. S. Patent No. 3,871,357 to Grosso et al.
U. S. Patent No. 4,793,323 to Giuda et al.
U. S. Patent No. 3,512,516 to Glass et al.
U. S. Patent No. 4,741,324 to Ina et al.
U. S. Patent No. 4,784,113 to Nagai et al.
U. S. Patent No. 4,640,264 to Yamaguchi et al.
U. S. Patent No. 4,857,047 to Gossett
U. S. Patent No. 4,067,313 to Donnelly
U. S. Patent No. 4,203,418 to Donnelly
U. S. Patent No. 3,889,483 to Donnelly

Sacharow, "A Hot and Cold Issue: Self Heating and Self Cooling Packages", Prepared Foods, V. 157, No. 10, September, 1988.

"Hot Can is Hot News", V. 60, No. 6, June, 1985. Commentary, V. 53, No. 633, Packaging, December, 1982.

The warmer pack of the present invention is disposable and is intended to be used in restaurants or with fast food outlets or other food carry-out establishments where the cost of the food warmer is in keeping with the cost of the food being sold so that the customer will pay for the cost of the food warmer either directly by an add-on cost, if the customer elects to have a food warmer, or indirectly where the food warmer

cost is already an integral part of the price that the customer pays. Typically, for a take-out hamburger, the warmer pack cost should be about ten cents or less. For pizza or chicken, the warmer pack can be larger and more expensive but only proportionally so relative to the ten cents for the hamburger. It is, of course, relatively easy to make a very expensive food warmer device such as have been used to heat the contents of a foodstuff container having a food or beverage contained therein.

In addition to the cost for a disposable food warmer pack, there is a serious problem of making the food warmer safe for use with foods, and for use by the customer, and particularly for use in the environment of fast food outlets. The warmer pack should be strong enough that the chemicals therein will not break out and mix with the food. Preferably, the warmer pack should be safe enough that if it is accidentally bitten by a person or a dog or other animal, that no serious injury occurs such as a burning of the mouth by chemicals. Since such disposable warmer pack may often be sat upon or stood upon, if they are dropped on a seat or on a floor, the preferred food warmer pack should be relatively strong and manufactured to meet such occurrences. When considering such safety and health considerations to be provided in a low-cost disposable food warmer of ten cents or so, the parameters and problems to be overcome are difficult.

In addition to cost, safety, and strength, the disposable warmer pack of the present invention must meet demanding criteria of providing a heat transfer in a controlled manner to match the cooling of the food to keep the food above a predetermined temperature at the end of a predetermined period--for example, twenty or thirty minutes. Often hot sandwiches such as hot dogs, roast beef or hamburgers, and chickens or pizzas are bought at a take-out counter and are brought home or to

another place f consumption where the food is eaten and this transport time is thought to be rarely longer than 20-30 minutes. Thus, the inexpensive disposabl warmer pack should be able to keep the food warm for an extended predetermined period of time--e.g., 20-30 minutes. Additionally, the warmer pack should be able to reach a relatively high temperature, for example 130°F. or 55°C. Not all warming devices can reach such high temperatures of 130°F or 55°C. Additionally, it is desired to reach the maximum temperature within a few minutes and to maintain a high temperature over a long period of time. Thus, the food warmer pack cannot have a very slow reaction time to reach the desired maximum temperature nor have a very fast reaction time to reach the maximum temperature followed by a rapid temperature drop. Rather, the preferred food warmer pack should have its temperature profile matched to that of the food so that the food is kept warm after preparation and throughout its transport and is maintained at the desired temperature for a period of 20-30 minutes. These times and temperatures are by way of example only. The food warmer pack should not heat bread, such as a hamburger bun to a very high temperature that will cause the bun to become soft by a subsequent water condensation. Additionally, the disposable food warmer pack should be flameless and not produce a gas. The food warmer pack should have a controlled and moderated temperature increase to prevent reaching temperatures that would burn a person handling the food warmer pack. Preferably, the food warmer pack should have good heat transfer properties.

Most fast foods have a conventional carry out package that they are already using. For acceptance by the food sellers as well as the food buyers, the disposable food warmer pack should be compatible with the conventional carry-out package. Thus, the food

warmer pack should be capable of being made a part of th carry out package or container or is an easily applied or inserted food warmer pack for use with the package.

From the foregoing, it will be seen that a large number of criteria need to be met for a commercially acceptable, a practical and inexpensive food warmer pack even though a need has long existed for such a product.

None of the patents and references cited herein above disclose a food warmer pack that is simple and inexpensive to manufacture, which is adapted to automated manufacture and filling and which is particularly adapted to maintain an elevated temperature of foods, which maybe eaten on the premises or which are carried out and consumed away from the premises.

Accordingly, the present invention is directed to a method and apparatus for maintaining an elevated temperature in food materials which are dispensed to the consumer.

Another object of the present invention is to provide a portable, flameless warming device that can be used to maintain fast food materials at an elevated temperature for an extended period of time.

A further object of the present invention is to provide a food warmer pack which is simple and inexpensive to manufacture.

A still further object of the invention is to provide a food warmer pack which is adapted to automated manufacture and filling.

These and other objects will become more apparent from the following detailed description and the appended claims.

Description of the Drawings

FIGURE 1 is a series of time-temperature plots for warming devices containing various proportions of exothermic compounds;

FIGURE 1A is a series of time-temperature plots for warming devices and sandwiches exposed to different environmental temperatures.

FIGURE 2 is a schematic, partially broken away, view of a warming device in accordance with the invention;

FIGURE 3 is a schematic view of another embodiment of the warming pack of the invention used in conjunction with the warming of a food material;

FIGURE 4 is another embodiment of the warming pack of the invention used in conjunction with warming of a food material;

FIGURE 5 is a further embodiment of the warming pack of the invention used in conjunction with receptacle for receiving a food material.

FIGURE 6 is a schematic diagram of a series of steps utilized in the automated manufacture of the warming pack of the invention.

FIGURE 7 is a depiction of a dispensing device for the warming packs of the invention.

FIGURE 8 is a further view of the dispensing device of FIGURE 7 shown in an open position.

FIGURE 9 illustrates a schematic flow chart for preparing hamburgers.

FIGURE 10 shows a pair of microwave ovens used to pre-warm food materials.

FIGURE 11 shows a preparation station for preparing pre-warmed food materials in accordance with the invention.

FIGURE 12 is a depiction of a warming station for maintaining the pre-warmed food materials at an elevated temperature, and

FIGURE 13 is a depiction of a disp nsing station for the pr -warmed food materials.

Summary of the Invention

The present invention is directed to a method and apparatus for maintaining an elevated temperature in fast food materials. The method involves the heating of the food until it is warmed, placing the heated food in a container for heat retention transport, activating a disposable warmer pack and associating the warmer pack with the heated food and the container for an extended period of time. The preferred warmer pack is formed inexpensively from flexible or rigid film laminates defining a thin package within which are two chemicals separated by an internal frangible barrier seal which is broken by pressure such as a squeezing pressure applied externally to the warmer pack. The frangible barrier seal divides the interior of the soft, flexible food warmer pack into two internal compartments. At least one compound is provided in the first compartment which is selected from those compounds which produce an exothermic reaction when mixed with a suitable liquid such as water. A liquid capable of initiating the exothermic reaction, such as water, is provided in the second compartment. When the barrier seal is ruptured by application of pressure to the warmer pack and the compound is mixed with the fluid, an exothermic reaction is initiated. The warmer pack is then located in proximity to a pre-warmed food material so that the development of the exothermic reaction serves to maintain the pre-warmed food material at an elevated temperature above ambient for an extended period of time.

Detailed Description of the Invention

Now referring to the drawings, the food warmer pack 11 of the invention is generally shown in FIG. 2.

The warmer pack 11 may be formed from a single, flat flexible or rigid sheet of heat sealable plastic which is doubled over and heat sealed around the perimeter to form a container having a bottom seal 13, a top seal 15 and side seals 17 and 19. Alternatively, the pack may be formed from two sheets of heat sealable plastic which are overlayed and heat sealed around the perimeter to form the warmer pack.

A frangible or rupturable seal means divides the pack into a plurality of internal compartments. The illustrated rupturable seal means divides the warmer pack into two compartments although more compartments than two could be made where more than two materials are to be mixed. The preferred rupturable seal means is in the form of a transverse heat seal 21 which divides the warmer pack into two compartments. A first compartment 23 contains a material or compound 25 which is capable of providing an exothermic reaction. A second compartment 27 contains a liquid 29 capable of initiating an exothermic reaction, such as water. The transverse heat seal 21 has a breaking strength substantially less than the perimeter seals 13, 15, 17 and 19. The breaking strength of the transverse seal 21 is selected so that when moderate pressure is applied to the warmer pack 11, the transverse seal will rupture, the contents of the two compartments become mixed and an exothermic reaction is initiated. Pressure to rupture the transverse seal 21 may be applied by any suitable method, such as by passing the warmer pack 11 through a pair of rolls, by squeezing the warmer pack by hand or by pressing the warmer pack with a plunger. Thus, the warmer pack 11 may be easily activated by either the person who is selling the food or by the food purchaser.

As will be explained in greater detail, it is possible to form an inexpensive, disposable food warmer pack from laminated plastic films which are heat-sealed

or adhesively secured to each other to define a flat, thin, inexpensiv food warmer pack that can be sold at a cost of about ten cents for a hamburger. The chemicals can be filled into webs of laminated plastic with the usual type of packaging equipment. The frangible internal seal 21 can be made easily with this type of equipment, as will now be explained.

An automated procedure for forming the warmer pack 11 is depicted in FIG. 6. A roll 31 of suitable, heat sealable plastic sheet material is unwound over tensioning rollers 33 and idler rollers 35 and 39. The sheet is doubled by passing through forming plough 41 and film guides 43 and 45. Vertical sealing bars 47 and 49 are used to form edge seals 17 and 19 (shown in FIG. 2) on two adjacent packs 11. Sealing bars 51 are used to form a heat seal 13 on the bottom of the warmer packs 11. Since the plastic sheet is doubled over at the bottom, the bottom heat seal 13 is optional. Reciprocating drive arms 53 are used to grasp the warmer packs 11 and to advance the packs to a severing station where severing knives 55 in combination with a transfer head 57 sever the pair of packs 11 and transfer the pair of packs 11 to a filling line.

The pair of warmer packs 11 are opened by suction cups 59 and advanced to a first dry chemical filling station where the packs receive a charge of a first dry chemical through filling funnels 61. The packs 11 are then advanced to an optional second dry chemical filling station where they may receive a charge of a second dry chemical through filling funnels 63.

Sealing bars 65 are then used to form a transverse seal 21 (shown in FIG. 2) which forms a first sealed compartment 23 in the pack 11. The transverse seal 21 has particular features as will be discussed more fully hereinbelow.

The pair of warmer packs 11 are then advanced to a third filling station where they receive a charge of a liquid, such as water through filling funnels 67. The order of filling can, of course, be reversed, i.e., the liquid can be added first.

Sealing bars 69 are then used to form a top seal 15 which forms a second compartment 27 in the warmer pack 11. The warmer packs 11 are then extracted through chute 71 to loading and packing equipment.

From the foregoing description, it will be apparent that the warmer packs 11 of the invention are integral self-contained warmer packs that are adapted to a plurality of modes of operation for maintaining pre-warmed foods at an elevated temperature as described more fully hereinbelow.

A warmer pack 11, such as shown in FIG. 2, may be simply activated and disposed within a container, such as a paper sack, containing one or more pre-warmed, fast food materials, such as hamburgers. This is the least efficient means for utilizing the warmer packs of the invention. The size of the warmer pack 11 may be altered, as shown in FIG. 3, so that one or more of the warmer packs 11 may be fitted inside the conventional paperboard or plastic receptacle into which sandwiches, such as hamburgers, are dispensed to the consumer. In another embodiment of the invention, as shown in FIG. 4 the warmer pack 11 may be affixed to a backing sheet 12 of a suitably flexible and stiff material, such as paperboard. The warmer pack 11 may then be located around the periphery of the hamburger, or its container. Interlocking tabs 14 are provided for holding the warmer pack in place.

In the embodiment shown in FIG. 5, the warmer 11 is disposed in the bottom of a receptacle 73 designed to receive a pre-warmed food material, such as hamburgers, chicken or pizza. The warmer pack 11 may be

placed loosely in the receptacle or may be adhered to the bottom. The transverse seal 21 may be ruptured by applying pressure on the warmer pack 11 by suitable means, such as a hydraulically-actuated plunger.

The plastic sheet materials are preferably multi-ply laminates of two or more plastic materials wherein the first or innermost plastic material is a heat sealable plastic. The outermost layer provides structural stiffness and strength to resist tearing or puncturing which would release the internal chemical materials. In some cases an intermediate layer may be utilized to provide specific structural or aesthetic features. The innermost heat-sealable layer is preferably selected from the group consisting of ionomers, such as Surlyn™, low density polyethylene, linear low density polyethylene, and polyvinylidene chloride. The outermost layer is preferably selected from the group consisting of polyesters, polypropylene, polyamides, cellophane and high density polyethylene. The intermediate layer, if used, is preferably selected from low density polyethylene, polyvinylidene chloride, aluminum foil, metallized polyester, metallized polypropylene, polypropylene and polyamides.

The warmer pack is preferably made to withstand being walked on or sat on or even bitten into without rupturing the perimeter seals which would release the chemical compounds. To these ends, the perimeter edge seals of the pack 11, i.e., the bottom seal 13, the two edge seals 17 and 19 and the top seal 15 preferably have a breaking strength of from about 1200 to about 5000 gms./in. whereas the transverse seal 21 preferably has a breaking strength of from about 300 to about 1000 gms./in. Seal breaking strengths are determined by the method of ASTM F88 and ASTM D882. The transverse seal 21 preferably has a breaking strength that is from about 4% to about 50% of the breaking strength of the

peripheral edge seals. Sealing conditions to obtain the desired seal strengths are the use of a temperature within the range of from about 100°F. to about 500°F. at a time of from about 0.1 to 5 sec. at a pressure of from about 10 to about 300 psig. Suitable sealing conditions are selected to provide the desired peripheral and transverse seal breaking strengths.

In general, compounds capable of an exothermic reaction are selected from the group consisting of calcium oxide (CaO), magnesium oxide (MgO) and calcium chloride ($CaCl_2$). These compounds are used in admixture with a suitable liquid, such as water to provide an exothermic reaction in the warmer pack of the invention.

Because of the low cost, calcined limestone and dolomite are predominately the material of choice for use in providing an exothermic reaction with water. A large number of prior art chemical heating devices are based on using calcined limestone or dolomite. However, the main disadvantage in the use of calcined limestone or dolomite is the alkalinity of the products of hydration. Hydrated limestone or hydrated dolomite have a pH of 11.5 to 12 and can cause burning of the tissue in the mouth if a person were to eat the warmed material along with the food material by accident. Limestone or dolomite, however, are suitable for warming the preheated food materials which are contained in rigid containers, such as a pre-warmed soup in a can, where the chance of the person or food coming in contact with the hydrated limestone or hydrated dolomite is minimal. In accordance with the present invention, however, a preferred embodiment of the invention utilizes a flexible container that is placed in close contact with warmed food material and limestone or dolomite is a least preferred compound.

MgO and $CaCl_2$ do not pose the health hazard of limestone or dolomite. Both MgO and $CaCl_2$ generate significant quantities f heat when mixed with water. The major difference between the use of MgO and $CaCl_2$ is in their rate of hydration and the rate of resultant heat release. $CaCl_2$ reacts relatively fast with water. MgO reacts with water at different rates depending on its grade and temperature. The reaction between MgO and water is relatively slow at a temperature of about 77°F. (25°C). The kinetics of hydration increase with temperature and they become rapid after a temperature of about 95°F.-104°F. (35°C.-40°C.) is reached.

While water is the preferred liquid for initiating the exothermic reaction for reasons of availability and cost, other fluids may be used for special situations. For example, in the embodiment shown in FIG. 5, the warmer pack 11 is disposed in a receptacle for the food material and is activated prior to placing the food material in the receptacle. Subsequently, the entire receptacle, containing the chemical thermal pack 11 and the fast food material, may be subjected to microwave heating to pre-warm the food material. Water could be vaporized to steam during microwave treatment generating significant pressure within the warmer pack. Pressure generated through such heating can be utilized to rupture the transverse seal 21. Inexpensive fluids having vapor pressures lower than water, such as propylene glycol or ethylene glycol, may be mixed with water to reduce the vapor pressure.

The heat release properties of both $CaCl_2$ and MgO depend on the water content, and the amount of heat released through reaction of the above compounds with water decreases with increase in their original water content. Anhydrous $CaCl_2$ and anhydrous MgO are preferred for use in the present invention. Commercial grade anhydrous $CaCl_2$ pellets and MgO containing less

than about 10% water by weight provide an optimum combination of heat release, cost, and filling convenience.

Commercial grade MgO is generally manufactured using sea water, limestone, or dolomite. People skilled in the art of production of MgO can control the calcium content of the MgO and its reactivity with water. The calcium content of the MgO should be kept as low as possible to insure that the pH after hydration is as close to neutral pH as possible. Calcium content of about 1% by weight or less is preferred. MgO of suitable reactivity is selected in the present invention to provide the required time-heat release properties to maintain the temperature of the food materials. For the purpose of the present invention, high reactivity MgO is defined as the grade whose kinetics of hydration are such that substantially all of the heat is released over a total time of 10 to 30 minutes in a temperature range of about 30°-60°C. For the purpose of the present invention, low-reactivity MgO is defined as the grade whose kinetics of hydration are such that substantially all of the heat is released over a total time of 20 to 40 minutes in a temperature range of about 40°-60°C. It is within the scope of the present invention to use both high-reactivity and low-reactivity MgO compounds in appropriate proportions to obtain the required time heat release properties. It is preferred to add low-reactivity MgO in cases where it is desirable to maintain the temperature of the food materials for periods longer than about 30 minutes.

MgO is also manufactured and sold in various size ranges. The bulk density of MgO decreases with a decrease in particle size range. It is preferred to use the larger bulk density MgO consistent with the reactivity considerations described above.

The proportion f $CaCl_2$, when used in combination with MgO in the current invention, is determined based on the amount of preheating required to produce the desired time heat release properties. The proportion of $CaCl_2$ is calculated by people skilled in the art according to the teachings of the present invention with the knowledge of the thermodynamic properties such as heat of hydration and specific heat capacity of the constituents including $CaCl_2$ and water, specific heat capacity of MgO and materials constituting the warmer package, and their corresponding weights.

Water added to the warmer pack described in the current invention has two purposes. First, it reacts with the other compounds to produce an exothermic reaction. Second, when present in higher than the stoichiometric proportion, it moderates the temperature increase. Temperature moderation is important to prevent burning of persons coming in contact with the warmer package and to control the kinetics of the exothermic reactions. The kinetics of reaction between water and MgO increase with increase in temperature in the temperature range of about 30° to 60°C. The proportion of water in relation to the other compounds is calculated by people skilled in the art according to the teachings of the present invention based on the rate of heat release; specific heat of water, compounds, and other materials comprising the warmer packages; and relative weights of each of the materials comprising the warmer packages. The preferred water content for the warmer packages described in the current invention is 80 to 200% of the weight of the other compounds participating in the exothermic reaction.

It is within the scope of the present invention to add additional ingredients such as salts or other

liquids to water to control the rate of exothermic reaction between water and the other compounds.

It is also within the scope of the present invention to add additional inert materials to the warmer pack for the purpose of temperature moderation.

The temperature profile of a flexible package in accordance with the invention is shown in FIGURE 1 wherein various combinations of MgO and $CaCl_2$ were used. The temperature profile is shown as a function of time. The total weight of solids of the exothermic material which was used to produce the plots of FIGURE 1 was 18g and the weight of water was 36g in each experiment. After initiating the reaction, the warmer pack was placed between two layers of insulation and the temperature was monitored as a function of time. In the experiment where pure MgO was used, i.e., 0% $CaCl_2$, the temperature increased relatively slowly for the first fifteen minutes until the temperature of the warmer pack reached about 86°F. (30°C). The reaction rate then increased significantly beyond this temperature. For the experiment in which pure $CaCl_2$ was used, the temperature increased to about 140°F. (60°C.) within about five minutes and decreased slowly thereafter due to heat losses. The experiments containing both MgO and $CaCl_2$ show a time-temperature relationship that is preferred in the use of the present invention to maintain the elevated temperature of a pre-warmed food product for an extended period of time. In particular, it is preferred to use mixtures of MgO and $CaCl_2$ wherein the $CaCl_2$ level is from about 15 percent to about 75 percent and the MgO is from about 25 percent to about 85 percent. All percentages used herein are by weight unless otherwise indicated.

The actual temperature of the warmer pack depends on the rate of heat loss from the warmer pack to the surroundings. The data discussed in relation to

FIGURE 1 was obtained by placing the warmer pack between two layers of insulation that minimize heat losses. The temperature profile of a package in accordance with the invention is shown in FIGURE 1A wherein the effects of placing the warmer packages in various surroundings are illustrated.

A preferred food warmer pack in accordance with the invention should reach a temperature of 130°F. (55°C.) or more within a few minutes and maintain the temperature for over thirty minutes. Calcium chloride can achieve the desired initial temperature rapidly. But since most of the heat provided by calcium chloride is released within the first few minutes, its temperature decreases with time. Magnesium oxide on the other hand has good heat release properties over long periods of time. However, when present on its own, MgO requires a long time period to reach a temperature of about 130°F. (55°C.).

The initial slow temperature response of MgO when used as the sole compound can be corrected by several methods. In one method, the warmer pack 11 can be preheated to a temperature of 30°C. to 40°C. prior to associating it with the food in the food container. Heat available from the pre-warmed food materials can also provide the heat necessary to preheat the warmers. This results in rapid heating of the food warmer pack. Preheating can be achieved by a number of means that include heating a dispenser for the warmer pack or by heating individual warmer packs by hot air or other external means, such as a microwave oven, prior to rupturing the transverse seal 21 and placing the warmer pack in proximity to a pre-warmed food material. However, as indicated, a preferred method is to provide mixtures of MgO and $CaCl_2$ wherein the $CaCl_2$ immediately reacts with water to provide initially rapid

temperature increase and the MgO sustains the temperature over long durations.

Positioning of the warmer pack in a proper position in proximity to the pre-warmed food material is important to maintain the temperature and to insure that the food does not deteriorate due to heating at undesired places. The position of the warmer pack depends on the type of food being maintained at an elevated temperature.

Optimum positioning of the warmer pack 11 of the invention for use with pizza is underneath the pizza. Usually the pizza is pre-cut at a pizza restaurant or outlet prior to delivery to the customer. The customer however may want to re-cut the pizza. Hence, it is desirable to provide a relatively strong barrier between the pizza and the warmer pack 11 to prevent cutting of the warmer pack at the time that the pizza is cut into portions. Optimum positioning of the warmer pack 11 for hamburgers is around the periphery of the hamburger patty. The most efficient and cost-effective positioning of the chemical thermal pack 11 for hamburgers, however, is on the bottom of the receptacle used to package the hamburger.

A series of experiments were conducted to determine the rate of cooling of a hamburger patty with and without the warmer pack 11 of the invention. In these experiments, the warmer pack 11 was formed into a toroidal shape and placed adjacent to the hamburger patty portion of the burger. The results of these experiments are given in Tables 1a and 1b.

TABLE 1a. RATE OF COOLING OF PATTY WITHOUT WARMERS

Expt. No.	Burgers* Reheated	Temperature of Patty, °C. 0 Min	5 Min	10 Min	20 Min	30 Min
CBX-1	Yes	67	63	61	57	53
CBS-2	Yes	64	59	54	48	46
CBS-2	Yes	60	55	53	47	45
CBS-4	No	48	46	44	41	39
CBS-6	No	46	43	40	37	36
CBS-7	No	44	43	43	41	40

All experiments were conducted using quarter-pounder cheeseburgers from McDonald's.

*"Yes" indicates that the burgers were reheated in a microwave oven.
*"No" indicates that the burgers were not reheated.

TABLE 1b. RATE OF COOLING OF PATTY WITH WARMERS

Expt. No.	Burgers* Reheated	Composition of Chemical Thermal Pack/gms. MgO	$CaCl_2$	H_2O	Temperature of Patty, °C. 0 Min	5 Min	10 Min	20 Min	30 Min
CBX-1	Yes	0	18	36	68	69	68	64	60
CBS-2	Yes	10	8	36	69	69	73	69	64
CBS-3**	Yes	10	8	36	65	62	60	57	54
CBS-4	No	0	18	36	47	47	47	46	44
CBS-6	No	10	8	36	49	49	48	47	45
CBS-7	No	18	0	36	44	44	44	43	45

All experiments were conducted using quarter-pounder cheeseburgers from McDonald's.

*"Yes" indicates that the burgers were reheated in a microwave oven.
*"No" indicates that the burgers were not reheated.
**Bag was not shaped to fit around the patty.

A second series of experiments were conducted to determine the rate of cooling of a hamburger patty with and without the warmer pack 11 of the invention. In these experiments, the warmer pack 11 was placed between the hamburger patty and the bottom bun. The results of these experiments are given in Table 2.

Table 2. Temperature of Hamburger Patties* With and Without Warmers* (Warmer Placed Between Bottom Bun and Patty)

EXPT. NO.	CONTROL/ TEST	WARMER	Temperature of Patty, °C. at 0 Min	11 Min	20 Min	30 Min	35 Min
BRK7	Control	No	49.9	45.9	44.2	41.8	38.7
BRK8	Test	Yes	44.3	47.5	55.7	60.2	50.4
BRK9	Test	Yes	38	43	47.9	58	49.9
BRK10	Test	Yes	39.8	49.9	52.7	51.3	46.1

* Whopper™ with cheese sandwiches purchased from Burger King.

BRK8: Warmer pack contained 15 gms. MgO and 30 gms. of water

BRK9: Warmer pack contained 12 MgO, 30 gms. H_2O

BRK10: Warmer pack contained 12 MgO, 20 gms. H_2O

A third series of experiments were conducted to determine the rate of cooling of a hamburger patty with and without the warmer pack 11 of the invention. The warmer pack 11 is placed under the bottom half of the bun of the hamburger which is inside the container used for serving the hamburger. The results of these experiments are given in Table 3.

Table 3. Temperature of Hamburger Patties With and Without Warmers*

EXPT. NO.	CONTROL/ TEST	WARMER	Temperature of Patty, °C. at 0 Min	11 Min	20 Min	30 Min	35 Min
1	Control	No	69	46	41	39	39
2	Control	No	54	44	38	34	33
3	Control	No	59	43	41	38	37
4	Control	No	60	45	43	41	40
5	Control	No	70	49	45	42	40
6	Control	No	77	50	47	45	43
1	Test	Yes**	79	64	57	52	50
2	Test	Yes**	57	46	47	46	45
3	Test	Yes**	48	46	48	46	45
4	Test	Yes**	64	52	53	51	49
5	Test	Yes**	71	66	58	53	51
6	Test	Yes**	58	58	57	54	52

* All experiments conducted using Whopper™ Sandwiches from Burger King.

**Warmer pack comprised of 10gms. of MgO, 8gms. of $CaCl_2$, and 30gms. of water.

A fourth series of experiments were conducted to determine the rate of cooling of pizza with and without the warmer pack 11 of the invention. In these experiments, three warmer packs 11 are placed on the inside top cover of the carry-out container. The results of these experiments are given in Table 4.

Table 4. Temperature of Pizza With and Without Warmers

EXPT. NO.	CONTROL/ TEST	WARMER	Temperature of Pizza, °C. 0 Min	5 Min	10 Min	20 Min	35 Min
1	Control (No Warmer Pack)	No	65	63	59	52	45
2	Test (With Warmer Pack)	Yes**	59	58	58	58	54
3	Control (No Warmer Pack)	No	76	68	63	54	45
4	Test (With Warmer Pack)	Yes***	81	74	76	70	59

* All experiments conducted using medium-pizzas from Pizza Hut.

** Three warmer packages each containing 18g of MgO and 30g of water were used.

***Three warmer packages, each containing 10g of MgO, 8 gms. of $CaCl_2$, and 30 gm of water.

It can be seen that the rate of cooling of the hamburger patty and pizza was significantly lower in the presence of the warmer pack of the invention in comparison to the controlled experiments in which no chemical thermal pack was used. This data demonstrates that suitable warmer packs for use in maintaining an elevated temperature in fast foods can be made utilizing MgO and/or $CaCl_2$ as the exothermic compound which is mixed with water.

The food warmer pack 11 may be stored in a storing means such as the box-like dispenser 100, as shown in FIGS. 7 and 8. In the illustrated dispenser, the food warmer packs are stacked vertically within a hollow interior 102 of the dispenser and are automatically activated when pulled from the dispenser by an activating means such as a roll or roller means 106 which has a nip 108 at which the pack is squeezed to rupture the internal seal 21 to cause the liquid to be intermixed with the compound to generate the exothermic reaction. Herein, the roller means comprises a pair of horizontally dispos d r ll rs 110 and 112 rotatabl ab ut

horizontal axes. These rollers are spaced apart a distance less than the thickness of the warmer pack at the nip therebetween. Release means including a lower inclined plate 113 serve to cause one warmer at a time to be guided into the nip. A pulling of the lowermost warmer pack from the dispenser pulls the warmer pack through the nip causing the internal transverse seal to rupture. The rollers force the liquid to move into the compound to wet it over a substantially large area of contact to achieve a good intermix of the liquid and compound over this wide and extensive area, thereby providing a large amount of mixed compound at the initiation of the exothermic reaction. This is in contrast to merely rupturing the rupturable seal and wetting only a small area of the compound with a slower rise to the desired upper temperature. If desired, heaters 116 such as electrical resistance wire heaters 118 may be provided in and about the bottom of the dispenser to preheat the liquid and chemicals in the lower few food warmers. This preheating aids in a faster chemical exothermic reaction.

In order to fill the dispenser 100, it may be laid on one side 120, as shown in FIG. 8, and another side 122 may be lifted and swung about a hinge 124 like a door to provide an opening 126 into which disposable food warmers are inserted to be packed on edge in a horizontal row in the hollow interior of the dispenser. After filling, the open door or side 122 is swung to close the opening 126 leading to the interior 102 of the dispenser.

The dispenser 100 assists in the quick and high volume usage of the warmer packs 11 in a fast food outlet. The warmer pack also can be used to change the system of use in a fast food outlet to eliminate some steam tables, heating lamps, and/or microwave oven that are used to stabilize the temperature of the hot sandwich, to reheat the meat or fish in the hot sandwich,

or to hold th sandwich temperature against heat loss at a dispenser area or chute. That is, rather than activating the food warmer pack only at the time of actually dispensing the food to the customer, the food pack may be activated much earlier and used during the initial period, e.g., 10 minutes of the sandwich formation to keep the cooked meat or fish warm and to stabilize its temperature followed by keeping the sandwich hot while it is at a dispenser area awaiting its removal upon sale to a customer.

Referring now more specifically to a specific hot sandwich systems shown in FIGS. 9-13, hot sandwiches may be kept warm with food warmer packs 11 thereby eliminating steam tables 130 (FIG. 12) and/or heat lamps 170 (FIG. 13) which serve to retain heat in the cooked food or hot sandwiches. While the food warmer may be associated with the food and receptacle in various manners, it is preferred that the receptacle 73 contain therein an integral or attached food warm pack 11 that is activated either by rollers 111 and 112 or some other device such as plunger which pushes against the food warmer pack 11 located on the bottom interior wall of the receptacle.

Referring now more specifically to a well-known system of making hot sandwiches, e.g., hamburgers, a box 134 of hamburger patties 136 (FIG. 9) is provided; and the uncooked hamburger patties 136 are placed on a cooking means 138, such as a grill conveyor 140 which carries the hamburger patties 136 over a cooking flame 142. On a lower conveyor 144, buns 146 are conveyed beneath the flames; and the buns are heated as they are conveyed through the grill, from left to right, to be discharged onto an inclined tray 148.

In the conventional system, the cooked hamburgers 136 are put between a bun top 146a and a bun bottom or heel 146b and the hamburgers/sandwiches are

placed in a steaming table 130 (FIG. 12), usually for about ten minutes to add heat to the hamburger sandwich s and to stabilize the temperature of the sandwich at 165°-170°F.

After stabilizing and heat addition, the hamburger sandwiches are taken from the steaming table 130 and taken to an assembly area 154 at which workers add lettuce, tomato, cheese, and/or condiments 155 onto the hamburger patty; and the fully-assembled hamburger sandwich is then put into a receptacle 73 and the receptacle with the hamburger sandwich therein is placed in a microwave 160 for a predetermined period of time to raise the temperature of the hamburger patty and bun because the vegetables, cheese and condiments applied at the assembly area cool the patty and because of the time at the assembly area the heated bun and patty are losing heat to the ambient air.

After being heated in the microwave, the hot sandwiches are placed in food chutes or holders 165 which hold a row of similar sandwiches for dispensing. About 12 to 15 inches above the food chutes are heat lamps 170 which reheat the packaged hot sandwich back to about 155°F. Preferably, these sandwiches beneath the heat lamps only remain there for ten minutes or less.

In accordance with present invention, the steaming table may be eliminated. Instead, the receptacle 73 of FIG. 5 may be taken to a position where a plunger squeezes the warmer pack 11 on the bottom wall to activate the warmer pack by rupturing the rupturable seal to mix the liquid and the compound to cause the exothermic reaction. The cooked patty and heated bun are placed in the receptacle with the heel 146b engaging the top of the food warmer. When taken to the assembly area 154 (FIG. 11), the activated food warmer will be adding heat and will not allow the rapid cool down previously experienced in the conventional manner. If desirable,

the hamburger patty and bun in the receptacle could be placed in a microwave to add heat to the packaged hamburger sandwich. Alternatively, the hamburger and patty could be placed in a microwave oven and heated to stabilize the temperature thereof prior to be placed in the receptacle 73 and prior to being taken to the assembly area 154. In any event, the finally heated hamburger sandwiches are then placed in the chutes 165 and the food warmer packs should keep the sandwiches warm for another 20 to 30 minutes. Thus, the food warmers may be used alone to keep the sandwiches warm or the heat lamps 170 may be retained. The dispensed hot sandwiches taken from the chutes 165 will be kept warm by the food warmers 11 whether eaten on premises or taken off premises and transported to a remote location for consumption.

WHAT IS CLAIMED IS

1. A method for maintaining an elevated temperature in pre-warmed food materials comprising

(a) providing a disposable warmer formed with a pair of opposed sheets of plastic material and divided into a plurality of internal compartments by a rupturable seal means,

(b) providing at least one compound in at one of said compartments, said compound being selected from those which produce an exothermic reaction when mixed with a liquid,

(c) providing a liquid in a second one of the compartments,

(d) rupturing said rupturable seal means and mixing said compound and said liquid to initiate an exothermic reaction, and

(e) locating said warmer in proximity to a pre-warmed food material so that the development of said exothermic reaction serves to maintain said pre-warmed food material at an elevated temperature above ambient for an extended period of time.

2. A method in accordance with Claim 1 wherein said sheets are a flexible plastic material.

3. A method in accordance with Claim 1 wherein said sheets are a heat sealable plastic material.

4. A method in accordance with Claim 1 wherein said compound is selected from calcium chloride, magnesium oxide and mixtures thereof and in which the liquid is water.

5. A method in accordance with Claim 4 wherein said compound is a mixture of from about 15% to about 75% calcium chloride and from about 25% to about 85% of magnesium oxide.

6. A method in accordance with Claim 1 wherein said container is heated prior to rupturing said rupturable seal means.

7. A method in accordance with Claim 1 wherein peripheral edge seals join dges of the pair of opposed sheets and have a breaking strength of from about 1200 to about 5000 gms./in. and said rupturable seal means has a breaking strength of from about 300 to about 1000 gms./in.

8. A method in accordance with Claim 7 wherein said seals are formed by gluing.

9. A method in accordance with Claim 7 wherein said seals are formed by heat sealing.

10. A method in accordance with Claim 1 wherein said container is affixed to a backing material to aid in locating said container in proximity to said food material.

11. A method in accordance with Claim 1 wherein said food material is a pre-warmed sandwich and said container is located inside a serving receptacle containing said hot sandwich.

12. A method in accordance with Claim 11 wherein said hot sandwich is a hamburger.

13. A method in accordance with Claim 1 wherein said food material is a pre-warmed sandwich and said container is formed into a toroidal shape and located around the periphery of said hot sandwich.

14. A method in accordance with Claim 1 wherein said food material is a pre-warmed sandwich and said container is located between the hot sandwich and one of the pieces of bread used to form a hot sandwich.

15. A method in accordance with Claim 1 wherein said food material is a pizza.

16. A method in accordance with Claim 1 wherein said food material is chicken.

17. A food warmer pack adapted for use in maintaining an elevated temperature in pre-warmed food materials, said pack comprising a closed container formed from two opposed sheets of a heat sealable plastic, said sheets being heat sealed around the peripheral edges

thereof to form said container, a rupturable seal means formed by heat sealing said sheets to form a plurality of enclosed compartments in said container, at least one compound located in first ones of said compartments; and at least one other compound capable of causing an exothermic reaction with the said compound in the said first ones of said compartment located in second ones of said compartments, said rupturable seal means having a breaking strength substantially less than said peripheral seals.

18. A warmer pack in accordance with Claim 17 wherein said compound in the said first compartment is selected from the group consisting of calcium chloride, magnesium oxide and mixtures thereof.

19. A warmer pack in accordance with Claim 17 wherein said first compound is a mixture of from about 15% to about 75% calcium chloride and from about 25% to about 85% magnesium oxide.

20. A warmer pack in accordance with Claim 16 wherein said other compound in said second compartment is water.

21. A warmer pack in accordance with Claim 17 wherein said peripheral edge seals have a breaking strength of from about 1200 to about 5000 gms./in. and said rupturable seal has a breaking strength of from about 300 to about 1000 gms./in.

22. A warmer pack in accordance with Claim 17 wherein the breaking strength of said rupturable seal is from about 5% to about 50% of the breaking strength of said peripheral edge seals.

23. A warmer pack in accordance with Claim 17 wherein said opposed sheets are two separate sheets.

24. A warmer pack in accordance with Claim 17 wherein said opposed sheets are formed from a single sheet which is doubled over.

25. A warmer pack in accordance with Claim 17 wherein said sheets of heat-sealable plastic are multiply

laminate she ts having an innermost layer of a heat-sealable plastic.

26. A warmer pack in accordance with Claim 25 wherein said plastic is selected from the group consisting of the following ionomers, low density polyethylene, linear low density polyethylene and polyvinylidene chloride or combinations thereof.

27. A system for keeping food warm before eating on the premises or after taking off the premises, said system comprising:

a receptacle for carrying pre-warmed food said receptacle being adapted to carry food of a predetermined kind having a predetermined cooling characteristic wherein when in said receptacle,

a warmer pack associated with the pre-warmed food and the receptacle,

said warmer pack having a timed heat release over a predetermined period of time matched to the predetermined cooling characteristic of said food material to maintain the food above a predetermined temperature until expiration of the predetermined period of time.

28. A system in accordance with Claim 27 in which the food is a hamburger and in which the the warmer pack has a timed heat release to maintain the hamburger at a temperature of about 50°C for over thirty minutes.

29. A method of dispensing a pre-warmed food material comprising:

heating a food material until it is warmer than ambient temperature,

placing the heated food in a receptacle for said food, and

activating a warmer pack and associating the activated warmer pack with the heated food and the container to maintain the food warm for an extended period of time.

30. The method of Claim 29 in which the step of activating the warmer pack includes breaking a frangible internal seal in said pack to allow mixture of two separated chemical components to generate an exothermic reaction.

31. The method of Claim 29 including the step of locating the activated, warmer pack into the interior of the receptacle and adjacent the food in the interior of the receptacle.

32. The method of Claim 29 including the step of wrapping the activated warmer pack on the exterior of the receptacle.

33. The method of Claim 29 in which the warmer pack is located on a wall of the container and in which the activating step comprises breaking a frangible internal seal within said warmer pack to allow two internal chemicals to intermix.

34. The method of Claim 29 in which the container is a bag containing a plurality of different foods and in which the warmer pack has an internal frangible seal and in which the activating step comprises breaking the frangible seal to allow internal chemicals in the pack to react with each other to generate heat.

35. The method of Claim 29 in which the food is a hot sandwich and in which the associating step includes the inserting of the food warmer pack between the bun and a wall of the container.

36. The method of Claim 29 in which the food is a hot sandwich and in which the warmer pack is located between the bun and the receptacle.

37. The method of Claim 29 in which the food is a hot sandwich and the warmer pack is attached to a paperboard backing strip which is then wrapped around the perimeter of the hot sandwich.

38. A food package comprising:

a food heated to a temperature warmer than ambient temperature,

a receptacle holding the food therein for on-premise eating and/or for transport, and

a disposable, warmer pack in the food receptacle activatable upon application of pressure to provide an exothermic reaction to maintain the food warm for an extended period of time.

39. A package in accordance with Claim 38 in which the warmer pack includes a frangible internal seal which is breakable upon application of pressure to the pack, to allow a mixture of two separated chemical components to generate an exothermic reaction.

40. A package in accordance with Claim 38 in which the warmer pack is in the interior of the receptacle and adjacent the food in the interior of the receptacle.

41. The package of Claim 38 in which the activated warmer pack is a band wrapped about the exterior of the receptacle.

42. The package of Claim 38 in which the receptacle has a wall, the thermal pack is on the wall of the receptacle, and in which a frangible internal seal is provided within the warmer pack to allow two internal chemicals to intermix when the seal is ruptured.

43. The package of Claim 38 in which the receptacle is a bag holding a plurality of different foods in the bag, the warming pack has an internal frangible seal and two chemicals separated by the seal, the breaking of the frangible seal allowing the chemicals in the pack to react with each other to generate heat.

44. The package of Claim 38 in which the food is a hot sandwich having a bun, the warmer pack being positioned between the bun and a wall of the receptacle.

45. The package of Claim 38 in which the food includ s a hamburger patty and a bun and in which the thermal pack is positioned between the bun and the hamburger patty.

46. The package of Claim 38 in which the food is a pizza and in which the receptacle has a large, flat wall to engage the pizza, said warmer pack in being inside the receptacle to keep slices of the pizza warm while other pizza slices have been removed therefrom for eating.

47. The package of Claim 38 in which the food is a hot sandwich, the warmer pack is attached to a paperboard backing strip provided with a lock, which strip is then wrapped around the periphery of the hot sandwich and is locked to keep the warmer pack in close peripheral contact with the hot sandwich around its circumference.

48. An inexpensive and disposable warmer pack for maintaining an elevated temperature in pre-warmed foods, said pack comprising:

a substantially flat top sheet of heat-sealable plastic,

a substantially flat bottom sheet of heat-sealable plastic,

said top sheet and said bottom sheet being joined together at their peripheral edges by seals that are capable of withstanding a first predetermined force applied to the pack,

a frangible seal internal of the package for joining the top sheet and the bottom sheet,

two discrete first and second compartments internally within the pack formed on opposite sides of the frangible seal,

a first material in the first compartment,

a second material in the second compartment,

the frangible seal being rupturable at a second predetermined force being applied to the pack, the second

pred termined force being substantially less than the first predetermined force,

the first and second materials being mixed to cause an exothermic reaction for heating the warmed foods.

49. A warmer pack in accordance with Claim 48 in which three heat seals join three peripheral edges of the top and bottom sheets and the fourth edge is formed by an integral fold joining the top and bottom sheets,

the frangible seal being formed by a heat seal between the top and bottom sheets.

50. A warmer pack in accordance with Claim 48 wherein said first material is a compound selected from those which produce an exothermic reaction; and said second material is a fluid capable of initiating an exothermic reaction with said first material.

51. A warmer pack in accordance with Claim 50 wherein said exothermic compound is selected from the group consisting of calcium chloride, magnesium oxide and mixtures thereof.

52. A warmer pack in accordance with Claim 51 wherein said exothermic compound is a mixture of from about 15% to about 75% calcium chloride and from about 25% to about 85% magnesium chloride.

53. A warmer pack in accordance with Claim 48 wherein said peripheral edge seals have a breaking strength of from about 1,200 to about 5,000 gms./in. and said frangible seal has a breaking strength of from about 30 to about 1,000 gms./in.

54. A warmer pack in accordance with Claim 48 wherein the breaking strength of said frangible seal is from about 4% to about 50% of the breaking strength of said peripheral edge seals.

55. A warmer pack in accordance with Claim 48 wherein said top sheet and said bottom sheet are two separate sheets.

56. A warmer pack in accordance with Claim 48 wherein said top sheet and said bottom sheet are formed from a single sheet which is doubled over.

57. A warmer pack in accordance with Claim 48 wherein said top sheet and said bottom sheet are multiple laminated sheets having an innermost layer of heat-sealable plastic.

58. A warmer pack in accordance with Claim 57 wherein said heat-sealable plastic is selected from the group consisting of ionomers, low density polyethylene, linear low density polyethylene and polyvinylidene chloride.

59. A dispenser for dispensing warmer packs for warming pre-warmed food materials, said dispenser comprising:

storing means for storing a multiple number of warmer packs, each warmer pack containing at least two compartments of solids and a liquid for an exothermic reaction and separated by a rupturable member;

means for releasing the warmer pack sequentially from the stack in the storing means, and

means for activating the warmer packs by rupturing the rupturable member to cause an exothermic reaction in the released warmer.

60. A dispenser in accordance with Claim 59 wherein the said dispenser contains 20 to 200 of said warmer packs.

61. A dispenser in accordance with Claim 59 wherein said warmer packs are stacked on top of one another in said storing means and the said means for releasing the said warmer packs comprises an inclined bottom plate and a slot with width and height dimensions somewhat larger than the same dimensions of said warmer packs.

62. A dispenser in accordance with Claim 59 wherein a bottom portion dispenser is maintain d at a temperature of 30° to 50°C. to preheat the warmer packs.

63. A dispenser in accordance with Claim 59 wherein the said warmer packs are stored in the dispenser in a substantially circular roll.

64. A dispenser in accordance with Claim 59 wherein the warmer packs included sheets and perimeter seals between edges of the sheets, an internal frangible seal divides the sheet into the two compartments internally within the sheets, the means for activating the warmer packs includes pressure means for applying a pressure higher than the rupture strength of the frangible seal and substantially lower than the rupture strength of the perimeter seal to the warmer packs to rupture the frangible seal.

65. A dispenser in accordance with Claim 64 wherein the pressure means comprises at least one rotatable roll and the said pressure is applied by pulling the said warmer pack through a nip defined partially by the rotatable roll.

66. A method of producing hot sandwiches having a named food therein comprising the steps of:

cooking the named food for a predetermined period of time,

assembling the cooked named food with a receptacle and with other ingredients of the hot sandwich,

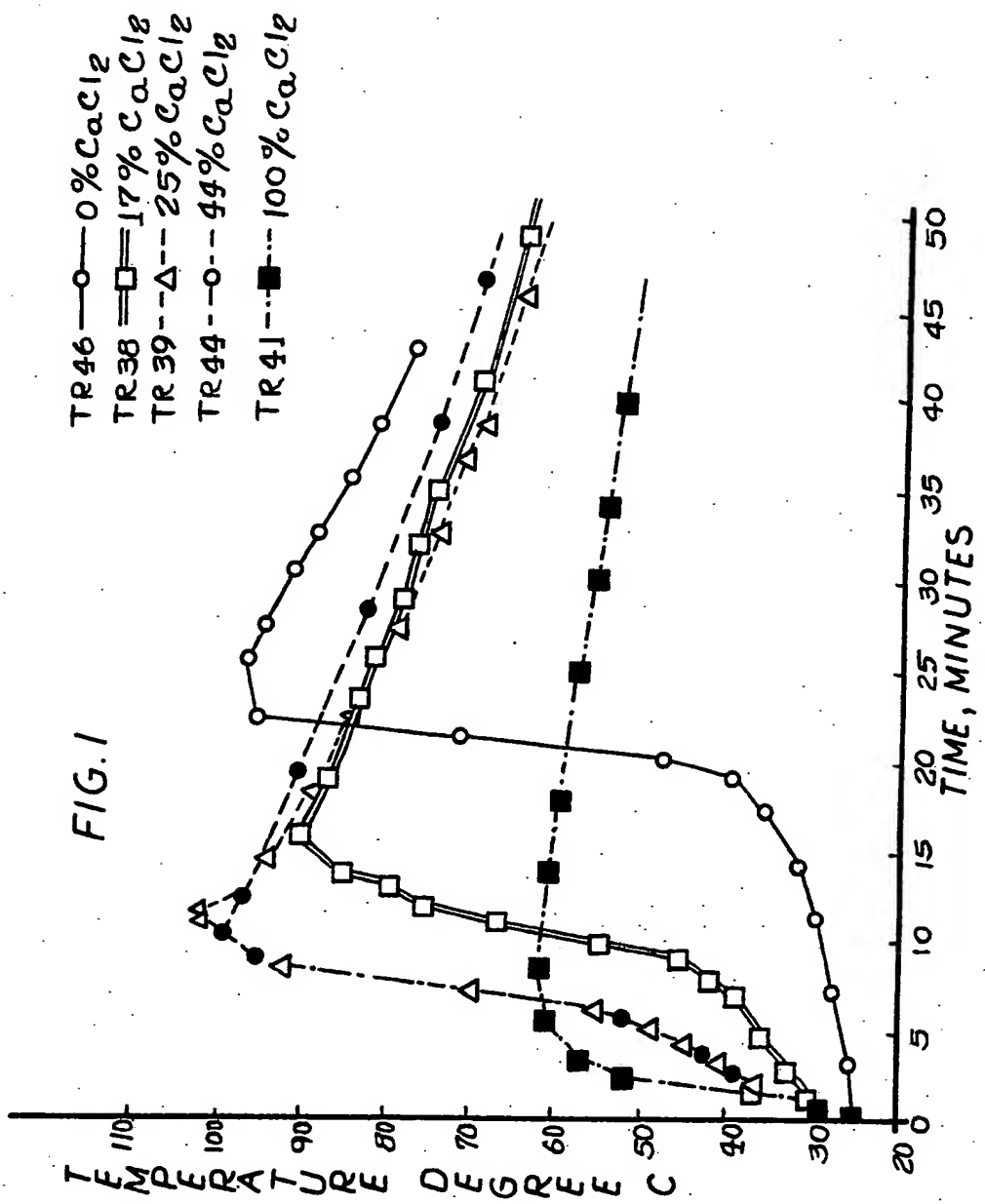
activating a disposable heat warmer having internal materials to mix and to provide an exothermic heat reaction to release heat to the assembled hot sandwich,

associating the disposable heat warmer with the named food and the receptacle, and

dispensing the warmed hot sandwich with the activated food warmer to keep the named food warm.

67. A method in accordance with Claim 66 including the step of heating the hot sandwich with a microwave oven for a predetermined period of time prior to associating the warmer with the food.

68. A method in accordance with Claim 66 in which the receptacle has a wall with a disposable food warmer thereon and in which the activating step comprises applying pressure to the food warmer to break an internal seal to mix a liquid with a compound within the interior of the food warmer to generate an exothermic reaction.


TR46 —o— 0% CaCl2
TR38 =□= 17% CaCl2
TR39 --Δ-- 25% CaCl2
TR44 --o-- 44% CaCl2
TR41 --■-- 100% CaCl2
TEMPERATURE DEGREE C
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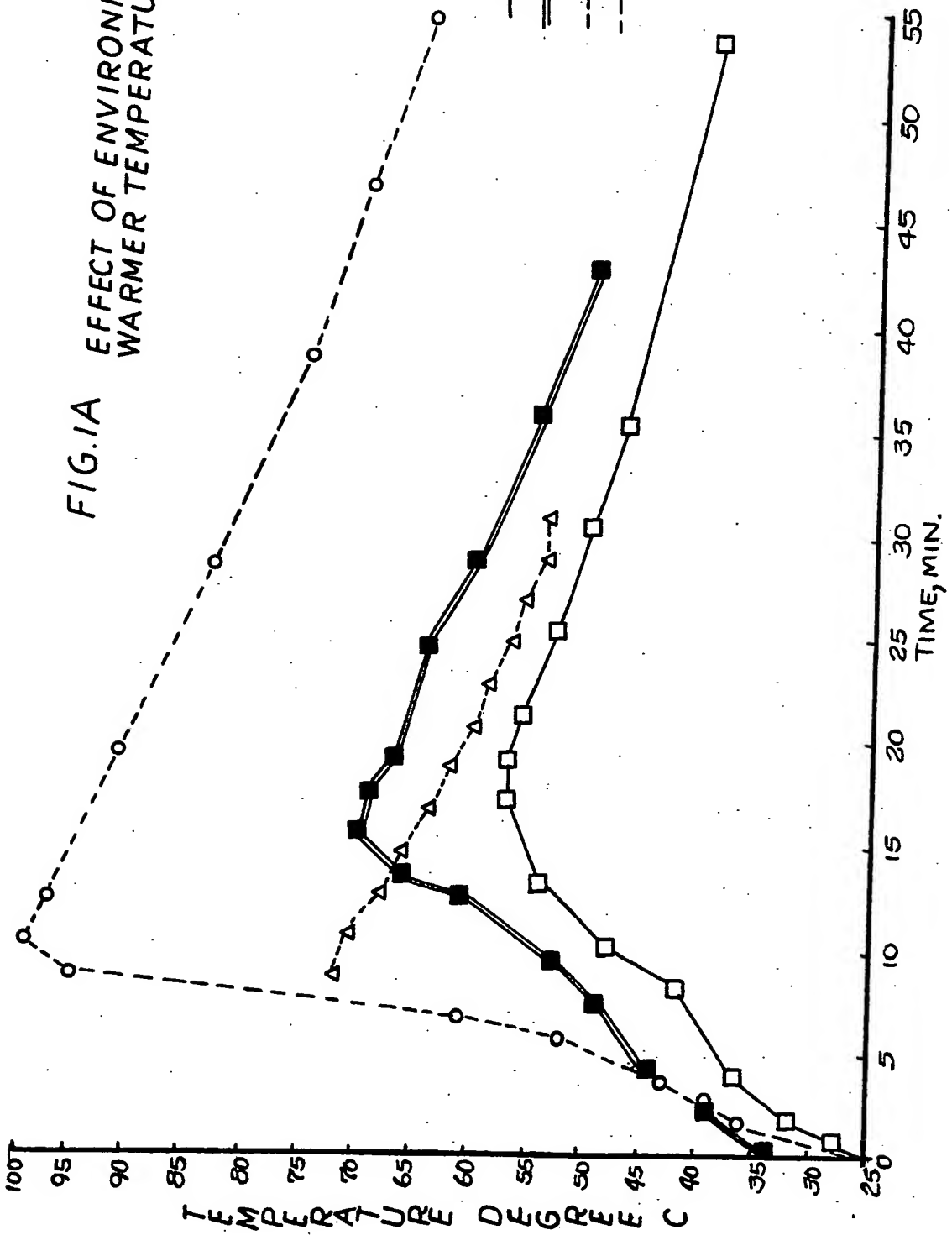
TIME, MINUTES

FIG. 1

FIG. 1A EFFECT OF ENVIRONMENT ON WARMER TEMPERATURE.



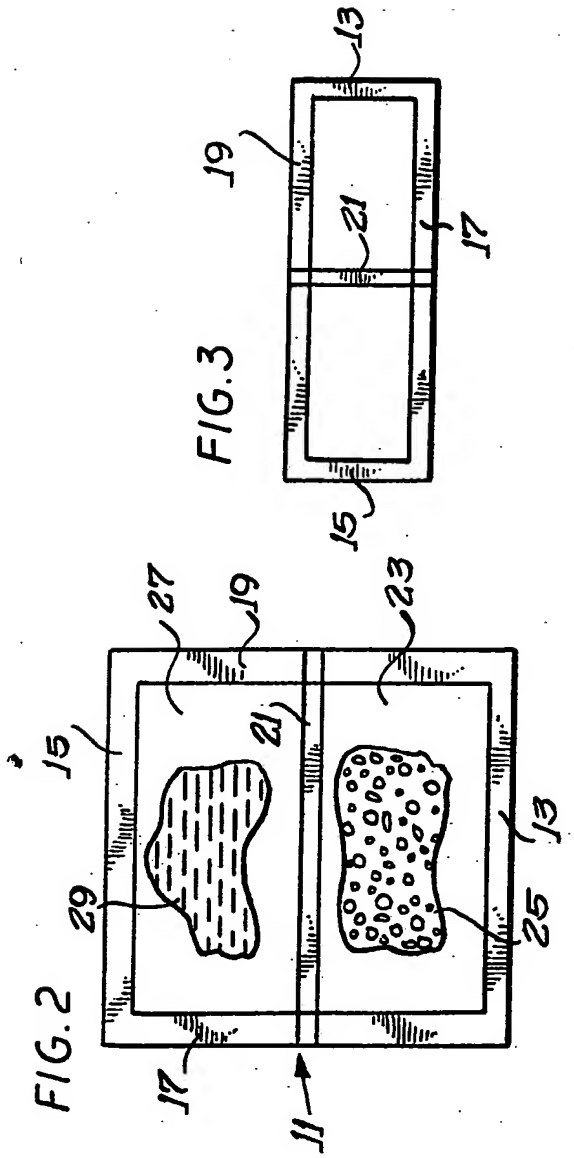


FIG. 2
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FIG. 3
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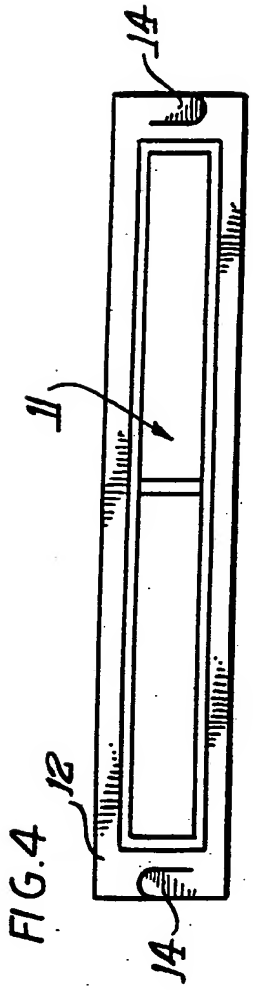
FIG. 4
14
11
12
14

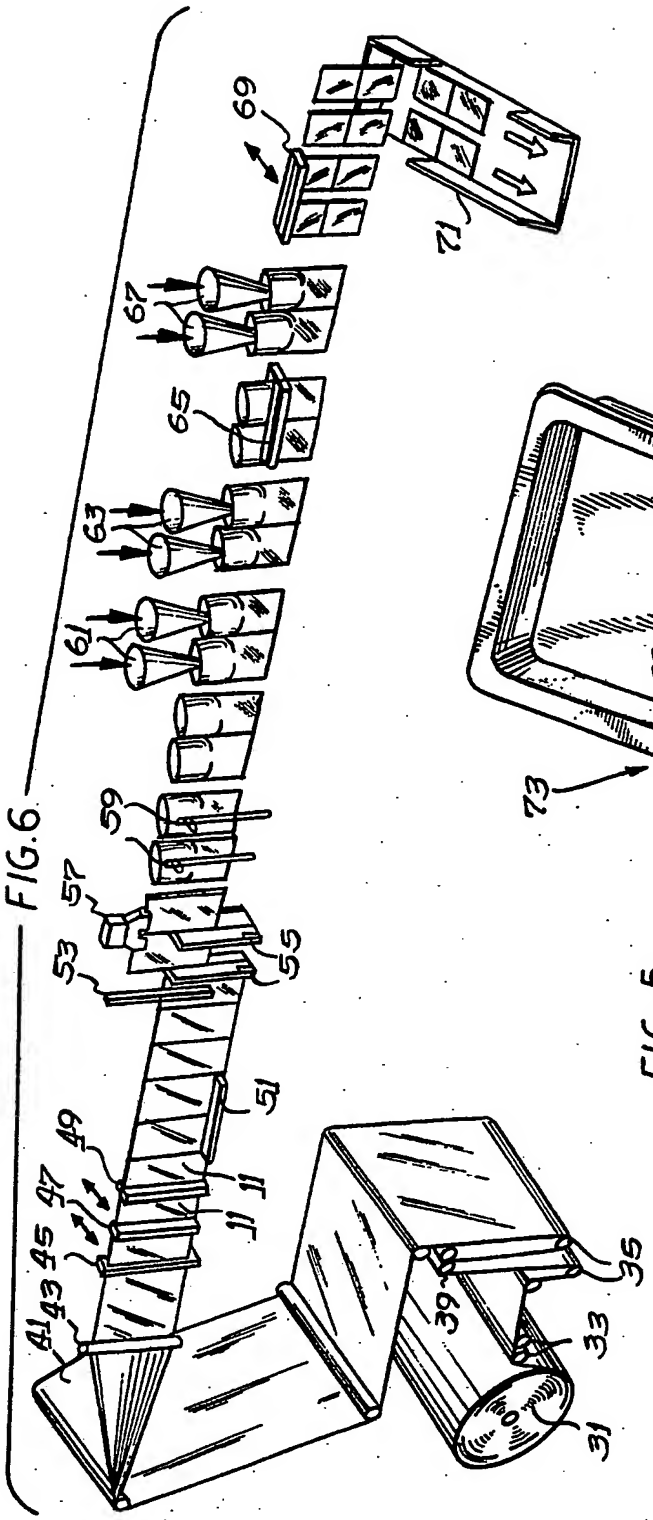
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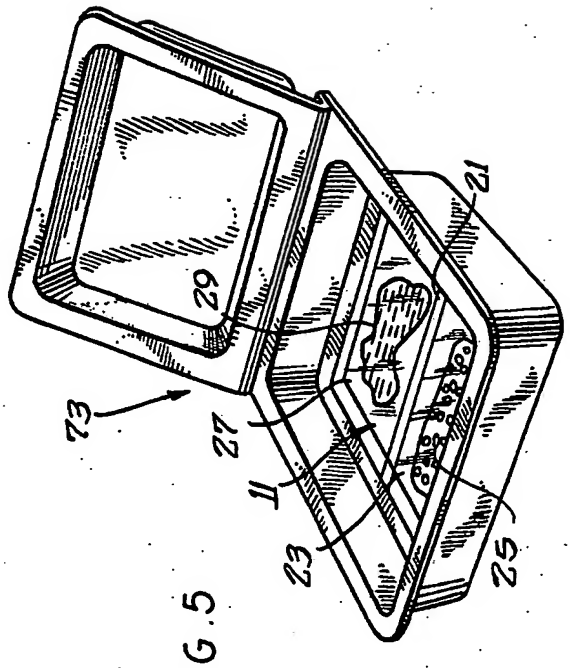
FIG.6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73
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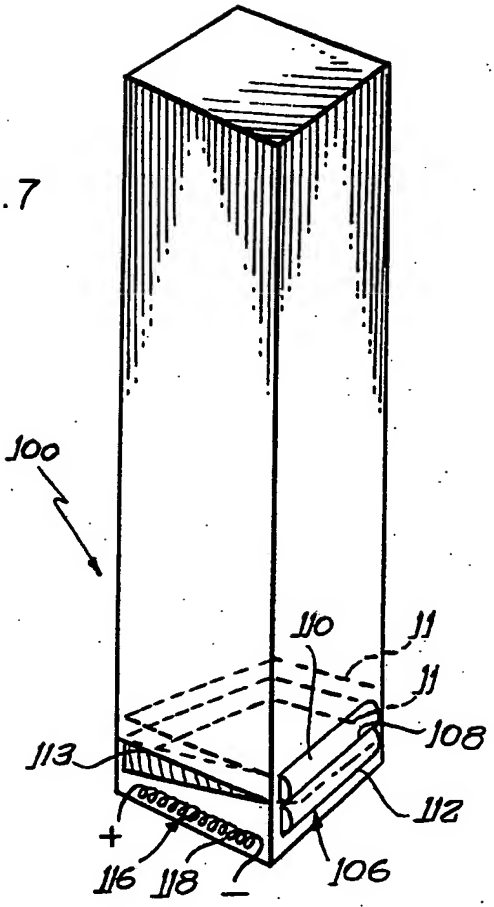
25

FIG.5

FIG.7


100
110
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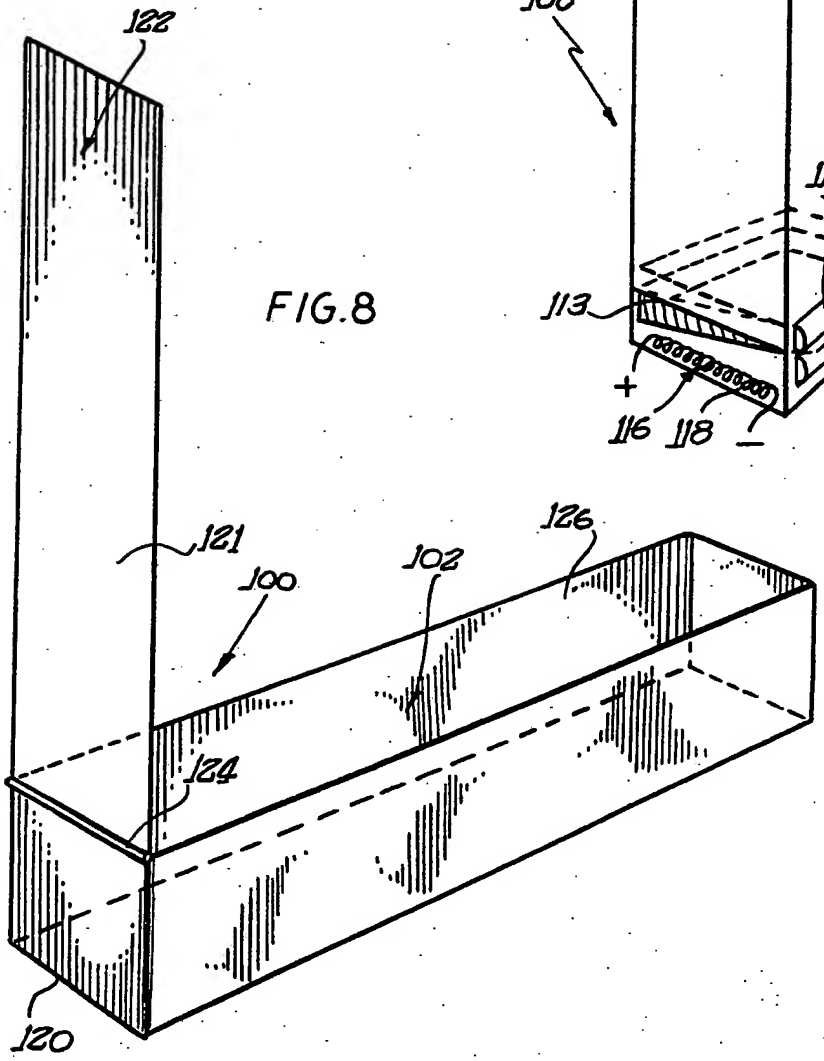
111
108
113
112
+
116
118
106

FIG.8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124
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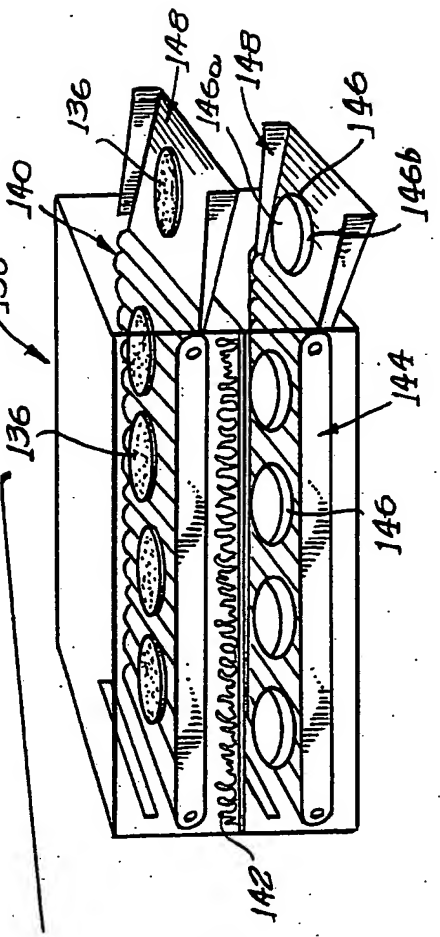
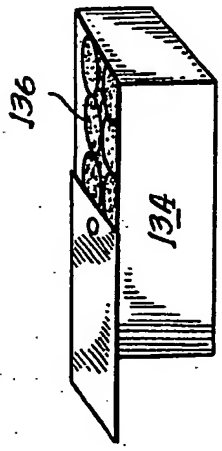


FIG. 9



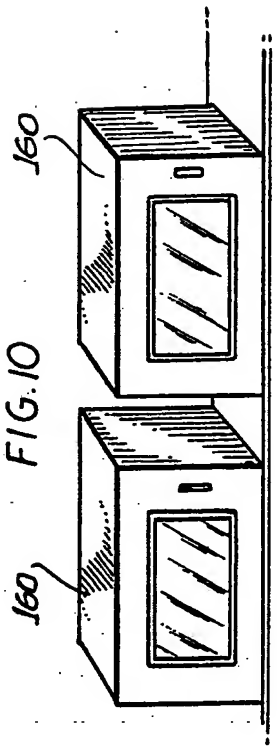


FIG. 10

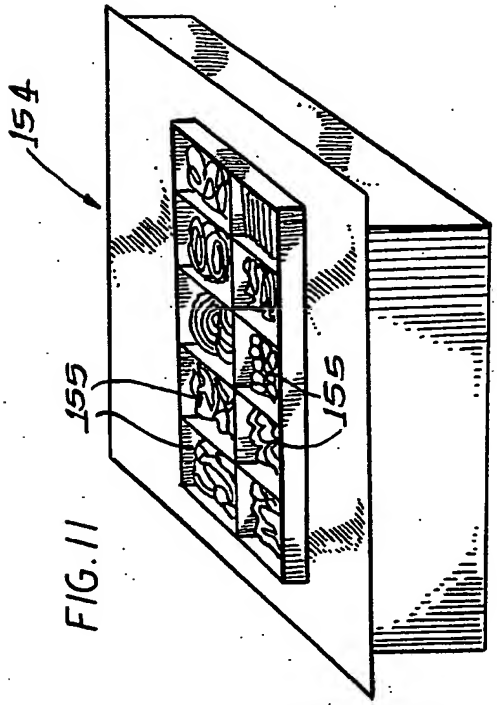
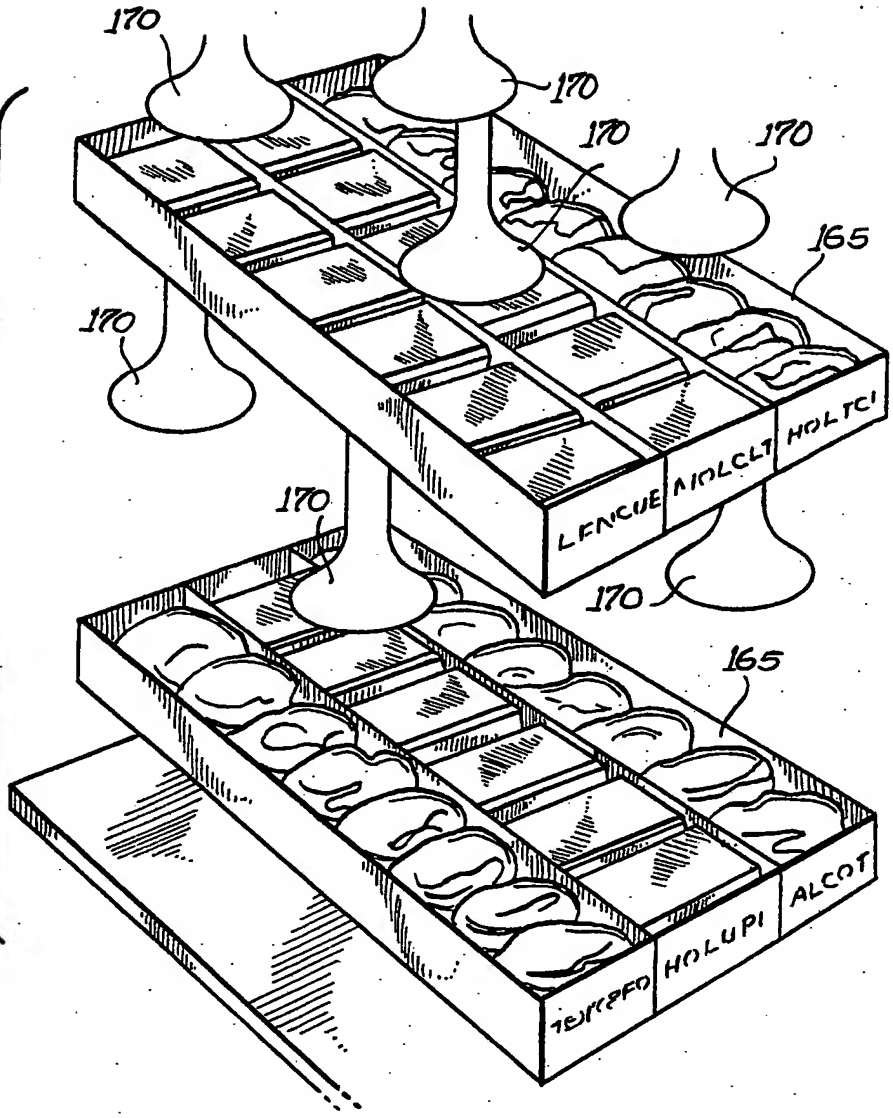


FIG. 11

FIG.13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LENCUE
MOLCLT
HOLTCI
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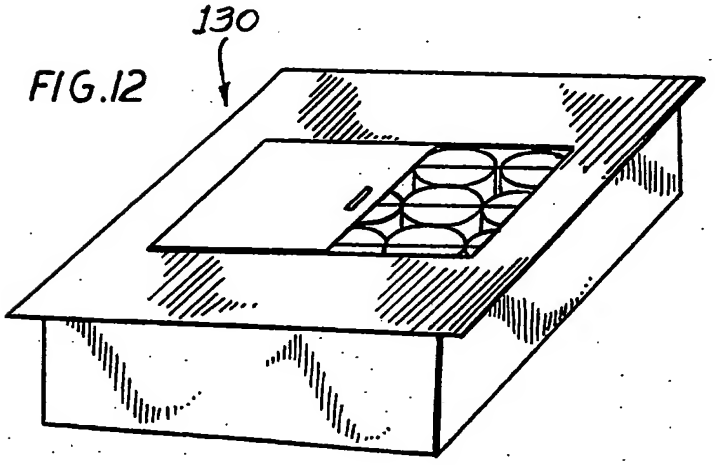
ALCOT
HOLUPI

FIG.12


130

INTERNATI NAL SEARCH REPORT

International Application No PCT/US 90/07529

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): F24J 1/00
US. Cl. 126/263

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System 5	Classification Symbols
US	126/263

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 6

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
y	US, A, 4,067,313 (Donnelly) 10 January 1978 see entire document	1-4,6-18,20-40 42-51,53-58, 66-68
y	US, A, 3,871,357 (Grosso et al.) 8 March 1975 see entire document	1-4;6-16,27-40, 42-47,-66-68
y	US, A, 2,916,886 (Robbins) 15 December 1959 see entire document	1-4,6-18,20-40, 31-33,35-40,42, 51,53-58,66-68
y	US, A, 4,762,113 (Hamasaki) 9 August 1988 see entire document	29,34
y,x	US, A, 4,559,921 (Benmussa) 24 December 1985 see entire document	29,31-33,35-40 42-47,66-68
A	US, A, 4,823,769 (Semaan) 25 April 1989 see entire document	1-68
y	US, A, 4,793,323 (Guida et al) 27 December 1988	4
y	US, A, 4,692,323 (Roman) 8 September 1987	4

* Special categories of cited documents: 15

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 2
14 February 1991	22 APR 1991
International Searching Authority 1	Signature of Authorized Officer 20
ISA/US	for Carroll B. Doritz/caw

Form PCT/ISA/210 (second sheet) (May 1986)

International Application No.
PCT/US 90/07529

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A/P	US, A, 4,895,135 (Hamasaki) 23 January 1990 see the entire document	1-68

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . . . . . , because they relate to subject matter [1] not required to be searched by this Authority, namely:

2. ☐ Claim numbers . . . . . , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [1], specifically:

3. ☐ Claim numbers_____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest.

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.